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Planning and Changing
Vol. 42, No. 1/2, 2011, pp. 101–119

IMPROVING TEACHER QUALITY IN SOUTHERN ILLINOIS: RURAL ACCESS TO MATHEMATICS PROFESSIONAL DEVELOPMENT (RAMPD)

This article describes how Southern Illinois University-Carbondale (SIUC) partnered with twelve rural schools with high percentages of students in poverty. SIUC provided faculty development activities featuring the adoption of Cognitively Guided Instruction, combined with activities to increase math content and to reduce math anxiety for groups of instructors lacking specific training in mathematics. The partnership is a positive example of a complex-brokered partnership, with instructional experts who were not members of the SIUC faculty. The success and sustainability of this partnership are analyzed to discover the factors that contributed to the durability of what may have been, in other circumstances, a fragile and weak partnership.

During the past half century great promises have been made about the educational benefits of school-university partnerships. Translating these promises into solid achievements in local schools is not a simple linear process. This case study describes the complexity of implementing a school-university partnership that reached out to elementary teachers of mathematics in twelve schools located in five rural Southern Illinois communities. A rigorous inservice professional development program was offered in Cognitively Guided Instruction (CGI), and forty-five teachers accepted the initial invitation. This proved to be a significant opportunity for the teachers who responded to engage in a journey of meaningful personal and professional learning. Each teacher confronted math anxiety, expanded math content knowledge, and developed new ways to teach and assess student learning in math. The number of teacher participants would grow over time, and the program boasts many successes that we will discuss. Yet many teachers avoided the training opportunity altogether, and wide variations of commitment occurred among the schools. This case study illustrates the contingent character of the implementation processes in educational reform within and between schools.

The Need for a School-University Partnership in Southern Illinois

Southern Illinois University-Carbondale (SIUC) serves a large rural region of Illinois that faces the serious challenges of poverty among families that move frequently under poverty's many stresses during their children's formative years. One common result of this poverty and mobility is compromised student achievement. Furthermore, low levels of mathematics achievement are a perennial problem. Many rural elementary teachers

who serve these children have limited educational credentials in the field of mathematics instruction. The vast majority have neither a major or minor in mathematics nor a mathematics endorsement. Leaders in the College of Education at SIUC recognized the need to strengthen and revitalize mathematics instruction for schools in their region. Through an Illinois Board of Higher Education (IBHE) Improving Teacher Quality (ITQ) state grant program (Title IIA), SIUC leaders formed the Rural Access to Mathematics Professional Development (RAMPD) partnership with Carbondale Elementary School District #95. The purpose of the RAMPD partnership (from 2007 into the present) is to build local and regional capacity to deliver exemplary mathematics instruction and improve student achievement. District #95 serves as the hub for a network of local public school districts and Lutheran schools that have participated in the partnership. This article elaborates on the process of developing greater capacity to deliver high quality elementary mathematics instruction through the development of a school-university partnership. We describe the partnership from its inception through the initial summative data collection.

A case study serves as the method of analysis (Gardner, 2011). The RAMPD case includes multiple evidentiary sources we discuss below. The case study of this developing partnership is bounded by the goals and purposes of the ITQ project that serve as the conceptual framework of this study. That framework uses Cognitively Guided Instruction (CGI) to enhance teachers' math knowledge and ability to apply discipline-particular teaching approaches or mathematics pedagogical content knowledge. In addition to these two critical goals, the RAMPD partnership provides math anxiety counseling and encourages the formation of a support network while teachers embark on this shared learning experience. This article describes key features that made this case unique and offers some preliminary guidance about school-university partnerships with the complex-brokered configuration. We discuss this configuration and offer this case study as a promising model for such partnerships when certain conditions are met (Baker, 2011). Included in this case study are appropriate supporting statistics that describe the pre- and post-testing of teachers, aggregated to show change patterns that resulted from the RAMPD partnership since 2007.

In the summer of 2007, the College of Education and District #95 formed a partnership to enhance mathematics instruction in K–8 schools in Carbondale and neighboring schools. In the fall of 2007, 33 teachers from eight schools launched the RAMPD program. Twelve additional teachers from two schools joined RAMPD in the fall of 2008. In 2010 the RAMPD grant was renewed, and the number of teachers and schools expanded again

Table 1 provides an overview of the RAMPD project and provides a demographic overview of participating teachers with student profiles for schools affected by the project: nine public and three parochial schools in five southern Illinois communities (i.e., Cairo, Carbondale, DeSoto, Meridian, and Murphysboro).

Table 1

Schools and Participating Teachers in the RAMPD 2007–2011 Program[a]

Schools	Total teachers	Teachers 2010–11	Teacher dropouts		Total participants	Dropouts as % of total	Participants as % of total	2010 % of total	School % of poverty
			RIF	Choice					
Immanuel	6.0	6	n/a	n/a	6	n/a	100	100	7
Lewis	16.0	12	1/8	0	13	13	81	75	70
St. Mark's	10.0	6	0	1/4	7	25	70	60	8
Parrish	30.0	10	2/5	1/5	13	60	43	33	48
Meridian	32.0	9	3/10	0	12	33	38	28	78
Desoto	14.5	5	n/a	n/a	5	n/a	34	34	64
Thomas	9.0	2	1/2	0	3	50	33	22	77
Carruthers	22.0	7	0/5	0/5	7	0	32	32	68
Cairo	45.0	9	n/a	n/a	9	n/a	20	20	100
Logan	24.0	2	0	2/2	4	100	17	8	60
C'Dale MS	25.0	1	1/4	2/4	4	75	16	4	64
St. John's	13.0	4	0	2/5	6	40	46	31	14
			Sums					Averages	
Totals	246.5	73	10	6	89	36	44	37	55

[a] Data from ISBE Report Cards, 2009.

As Table 1 indicates, RAMPD's public school teachers serve many children living in poverty who meet the federal qualifications for free and reduced lunches. RAMPD reaches out to twelve schools, and the total number of teachers reached provides a busy agenda for the small staff who carry out the work of the grant. RAMPD has broad appeal to leaders in several schools, but the level of participation in these schools varies greatly. In some schools a sizable group of teachers in the school responded, and in other cases only a few teachers took advantage of the learning opportunity. The vast majority (87%) of the teachers who joined RAMPD and had the choice have stayed with the training opportunities it offers. The issues of variability and loyalty in participation are addressed later in this article.

Designing RAMPD to Meet the Educational Needs of Teachers

SIUC identified a need for improving instruction, and many teachers responded to this invitation to grow professionally. The invitation asked teachers to join a multi-faceted project with several distinct goals and venues for learning. First, the designers knew that many teachers have considerable anxiety about their math skills. For professional development to have the desired effect, the partnership needed to help teachers gain new confidence as effective math instructors. This concern was met by providing a diagnostic assessment of math anxiety and one-on-one targeted counseling support. Second, some teachers needed greater content knowledge of mathematics. This need was addressed with a two step approach of evaluating each teacher's mathematical knowledge and addressing weaknesses through targeted support provided in four formats: (a) one-on-one consultation; (b) guided online instruction provided by the National Council of Teachers of Mathematics; (c) small group sessions; and (d) a university course taught by a professor working with RAMPD. Third, the partnership offered teachers opportunities to learn the most effective practices in mathematics instruction. The grant designers responded to this need by adopting a major innovation in mathematics education—Cognitively Guided Instruction (CGI)—and provided systematic, sustained training in this program that has demonstrated its efficacy (Carpenter, Fennema, Franke, Levi, & Empson, 2000). Fourth, each school needed to develop a focused collegial support network with various aspects of CGI and other exemplary practices currently found in mathematic education.

With this comprehensive design, the planners at SIUC and District #95 had a clear vision in their plans for embedded professional development in the participating schools. In their proposal, RAMPD developers aspired to "establish a community of practice at each school site through which teachers learn about the development of children's mathematical thinking followed by examination of how their own students think mathematically" (Ashby, 2007, p.2). The proposal also stated that the ITQ project will "engage teachers in classroom research through which they collect

and analyze data regarding their students' mathematical thinking processes" (Ashby, 2007, p.2). Planners understood that teachers needed extended on-site expert support throughout the duration of the professional development program. This need is addressed through a system of ongoing on-site visits by cognitive coaches assisting the teachers with instructional practices and classroom research. The implementation of this comprehensive approach occurred through a systematic sequence of planned activities over a period of three years. The first three-year cycle is completed, and a second phase of the RAMPD partnership was funded in 2010 to further develop the instructional capacity of rural schools in southern Illinois.

Creating a Partnership Structure to Connect the University and the Schools

The structural arrangements of the RAMPD program have evolved over time. In the initial phases of the ITQ grant, it was a relatively simple structure in which Susanne Ashby, working under the direction of the assistant dean of the College of Education, held a series of planning meetings with Linda Meredith, the Superintendent of the Carbondale Elementary School District. They determined that SIUC would "offer professional development in the forms of indepth math knowledge for teachers (on an individualized basis) and through the process of Cognitively Guided Instruction (long term training)" (Ashby, 2007, p.2). This agreement between executive level leaders in the SIU College of Education and the school district had two important implications. First, the RAMPD program was voluntary for teachers in each of the four schools in Carbondale. The training program was individualized and gave each teacher sophisticated and customized support, but teachers were not to be coerced into participation. Secondly, the cognitively guided approach to instruction is highly demanding and forces teachers to re-examine their beliefs about instruction, their content knowledge of mathematics, and their daily teaching habits. These kinds of commitments to "improve teacher quality" take time and considerable effort because they are expected to be profound and of enduring value.

During the first three years of funding, Susanne Ashby served as the Project Director and hired staff, organized planning meetings, and coordinated professional development activities. Dr. Cheryl Lubinski served as the CGI Coordinator and was responsible for designing and delivering the CGI instructional program to the RAMPD staff and participating teachers. Dr. Lubinski is a retired professor from Illinois State University who is an accomplished researcher, trainer, and CGI consultant. The final two key positions are those of cognitive coaches. These individuals provided consultations in numerous settings, including on-site visits to teachers' classrooms. Two former teachers—Jennifer Prusaczyk and Linda North—with special training in mathematics education serve as the cognitive coaches. Jennifer Prusaczyk is a doctoral student at SIUC, and Linda North is a re-

tired teacher from District #95 and a former recipient of the Presidential Award for Excellence in Teaching. The roles played by Ashby, Lubinski, Prusaczyk, and North constitute the central functions of the training program, but other positions also deserve brief mention.

The Mathematics Content Coordinator (Dr. Mary Wright) serves as a special consultant, assists with on-line coursework, and teaches a university course for RAMPD participants. Dr. Wright is a professor of mathematics at SIUC. A second position is the Math Anxiety Counselor—Dollean York-Anderson—who offers small group sessions and one-on-one counseling for those teachers with high math anxiety scores. Dr. York-Anderson is a clinical psychologist from a private counseling agency. The final position designed to maintain a reliable relationship between the university and the schools is the District Liaison. Linda North serves in this role. She "works closely with project team members to schedule all activities, trainings, classroom observations, and Institutes" (Ashby, 2007, p. 2).

The initial design for the RAMPD partnership is best described as an improvised structure that has many positions filled by professional educators who represent SIUC, but, in fact, have been hired as outside experts with special qualifications. The partnership is a complex-brokered arrangement in which the three instructional experts who spent the most time with the teachers (i.e., the CGI Coordinator and the two cognitive coaches) were not regular members of the SIUC faculty. In complex-brokered partnerships, the partners rely on outside consultants for all or most of the project's professional development activities (Baker, 2011). The Improving Teacher Quality (ITQ) state grant program included several partnerships in this configuration. For the RAMPD project, the only expert in the field of mathematics from SIUC is the Mathematics Content Coordinator, who played an important supporting role. On the surface, this arrangement might appear rather fragile and unlikely to yield a strong partnership between SIUC and schools in the region. In fact this brokered arrangement proved to be quite durable for the first four years of the RAMPD program. Factors contributing to this durability are addressed below.

Implementing the RAMPD Program: Describing the Process of Planned Change

The origins of the RAMPD partnership began in the spring of 2007 with an internal needs assessment in District #95 that identified math instruction as a high priority for school improvement. Later in the summer the superintendent shared this concern with Susanne Ashby from SIUC. In short order a school-university partnership focused on this issue was forged between the two institutions. The summer of 2007 was spent working out the details of the RAMPD project, and in August it was presented to principals and teachers as a professional development opportunity for all teachers (i.e., general and special education teachers) from kindergarten through eighth grade.

In the fall of 2007 the Project Director invited other school districts and parochial schools to participate in the RAMPD project. She also recruited and hired staff members who would begin work in January, 2008. In the winter of 2008 two additional schools from Murphysboro District #186 joined the project as it expanded beyond Carbondale into other communities. At the same time, participating teachers began to take a series of diagnostic assessments for math anxiety, content knowledge of mathematics, and critical thinking skills. After completing the assessments, each teacher met with one of the cognitive coaches to share the results confidentially and to develop an individualized professional development plan for mathematics (IPDPM) that addressed the unique needs and opportunities of the teacher. Appropriate interventions were considered (e.g., math tutors, on-line courses, university courses), and an ongoing supporting relationship was established between teachers and cognitive coaches.

The teachers who joined RAMPD were eager to become better math instructors, but most of them knew nothing about CGI and how much it would challenge their ideas about math education. CGI begins with a basic premise: "Children enter school with a great deal of informal or intuitive knowledge of mathematics that can serve as the basis for developing understanding of the mathematics curriculum of the primary school curriculum" (Carpenter, Fennema, Franke, Levi, & Empson, 1999, p. 4). Teachers must learn to understand the students' approach to solving mathematics problems and then build on their initial solutions. "Teachers learn from listening to their students and struggling to understand what they hear" (Carpenter & Franke, 2004, p. 45). CGI does not provide a set curriculum for teachers to follow nor does it specify one-size-fits-all "best practices." The founders of CGI present a bold challenge to teachers, "Our goal is not to provide teachers with a static body of knowledge, but to help them develop conceptual models of student thinking that they can use for engaging in practical inquiry in their classrooms so that learning becomes generative" (Carpenter & Franke, 2004, p. 45). CGI is about inquiry into the learning processes of both teachers and students. It requires a radically new way of thinking about math instruction, and it placed authentic demands for personal and professional growth on the teachers in the RAMPD partnership.

The winter and spring of 2008 served as the time for preparation of an intensive five day CGI workshop held in early June. Professor Lubinski conducted the CGI Institute for all teachers and the RAMPD staff, including Professor Mary Wright from SIUC. Marlow, Kyed, and Connors (2005) describe the initial detachment of principals in similar programs, and not surprisingly, principals were conspicuously absent from the Institute. During the fall of 2008, a special one day workshop was held for principals from participating schools. The day was dedicated to explaining the CGI philosophy and instructional methods, and reviewing the local school logistics and capacity for embedded professional development activities during the coming year. The principals' questions ranged from discussion of learning theories to prac-

tical topics about new curriculum materials and scheduling details. This was a crucial day for the RAMPD partnership, especially since the principals had not participated in the initial planning stages of the program.

After the opening CGI Institute, the teachers had the rest of the summer to plan new math lessons. Regular meetings were held for all RAMPD teachers in the fall, and special sessions were organized for each school. Some teachers chose to take university courses with Professor Mary Wright and other faculty members at SIUC. The cognitive coaches also began a series of one-on-one visits with teachers in their classrooms and other settings. Teachers were given new teaching tools and materials, including math manipulatives, document cameras, and LCD projectors. Finally, numerous e-workshops were scheduled on various topics related to mathematics instruction (e.g., "Problem Solving in Grades 3–5"). Two additional CGI Institutes were also given by Dr. Lubinski during the next two summers—2009 and 2010. Many professional development activities were provided for the teachers, but more significantly, these activities were integrated into the daily work of teachers (Guskey, 2002; Wood & McQuarrie, 1999). Many opportunities for feedback with fellow teachers and consultations with the cognitive coaches were provided as well. This was in-depth training on the job.

Another important aspect of the RAMPD project was the unique role played by Dr. Lubinski. She is a skilled and experienced facilitator who can both challenge and support teachers as they make the changes CGI demands. In this complex relationship Lubinski exceeded conventional expectations of professional development trainers. Rather than offering short workshops or single day seminars, she provided an intense week of CGI fundamentals and then followed up with numerous reinforcement opportunities. Lubinski worked closely with the cognitive coaches, who then followed up in the schools with regular support for teachers developing new knowledge and skills and changing their routines of practice.

Lubinski also continued to consult with teachers frequently throughout the school year. She accompanied cognitive coaches on classroom visits to observe math lessons and then met with the teachers during planning periods. She used each of these occasions as rigorous training sessions. Lubinski had sufficient strength of character and commitment to call into question teaching practices she recognized as ineffective for student learning. On some occasions she co-taught lessons and assisted teachers in developing their understanding of assessment as it related to CGI. She was flexible in scheduling, allowing Saturday meeting opportunities for the benefit of teachers. Lesson planning, driven by state standards, was also strengthened through support sessions where grade level participants practiced planning a lesson based on assessments of student work. The procedure lasted a whole school day and was implemented by Lubinski and developed in conjunction with other CGI professional development providers.

Susanne Ashby directed the RAMPD program during the first three-

year cycle (2007–2010) of ITQ funding until another SIUC administrator, Jackie Cox, assumed the duties of renewing the RAMPD proposal for a second three year funding cycle started in 2010. The newly revised RAMPD program builds on many of the original components, but it also makes some significant modifications. First, all participating teachers were once again invited to continue their training with CGI instruction, and the vast majority accepted the invitation. These teachers will receive advanced training from Cheryl Lubinski and the cognitive coaches. Second, additional schools and a second cohort of 42 teachers joined the project. They are now going through the same rigors of comprehensive assessment and developing individualized plans for professional learning, as did the first teacher cohort. Third, a cadre of teacher leaders were recruited in six schools, and new efforts are planned for establishing professional learning communities in these and other schools. Fourth, a new position, Administrator Liaison, has been established to support principals. This position, filled by Dr. Elizabeth Lewin, is designed to develop a stronger connection between the principals and the teacher leaders who are able to advance the mathematics program in the school. And finally, the new RAMPD partnership will be extended to include the Regional Office of Education #30, the regional professional development center, tasked with sharing management logistics and growing the program. In short, strong features of the original RAMPD design were kept and new features added to strengthen internal networks in each school and external networks throughout the public school system in southern Illinois.

Assessing Results

The results reported in this section of the paper are based on several methods of data collection and analysis during the past four years of the RAMPD partnership. The first author, Jennifer Prusaczyk, joined the RAMPD project as one of the cognitive coaches in January of 2008. She participated in every facet of the partnership and collected and managed the data sets on teacher assessment. The second author, Paul Baker, made several visits to the SIUC campus, District #95 office, and eight of the twelve participating schools, representing the Illinois Board of Higher Education as a member of the Center for the Study of Education Policy (CSEP), the meta-evaluation group studying all the ITQ projects. He conducted repeated interviews with teachers and the key leaders in the RAMPD partnership. Baker has also made repeated observations of CGI training sessions and classroom lessons that utilize various CGI instructional strategies. Finally, the authors studied all evaluation reports written by the external evaluator, Maberry and Associates.

The evidence presented in this section examines three kinds of results. First, we share findings about various opportunities for professional growth that the RAMPD program provided to teachers in twelve southern Illinois schools. Second, we examine the outcomes for teachers who took

pre-post assessments of their math anxiety and their content knowledge of mathematics. And finally we explore results that look at student learning. All of these findings are exploratory. While much has been learned, we make no claim to definitive results or final verdicts on the success or failure of the RAMPD program. RAMPD remains a work in progress, and these results offer important clues about critical issues that need further study and development.

Teachers Who Responded to RAMPD

Table 1 and our earlier description present a portrait of RAMPD with its highly varied levels of teacher participation. In some schools there is a sizable group of teachers and in others very few. This local variability is similar to other ITQ grants funded by IBHE during the past seven years: participation is a voluntary decision by each classroom teacher. Like most ITQ grants, RAMPD was launched to provide needed educational opportunities to all teachers in targeted schools where students were underperforming in math, science, or reading under Title IIA. Despite the fact that RAMPD addresses an urgent need and provides an opportunity for professional learning from a highly skilled team, many if not most teachers in the targeted schools failed to take advantage of this funded program. A select group of teachers responded with enthusiasm and energy, but these volunteers worked in the same schools as colleagues who showed little interest in learning new mathematics content knowledge or improving instructional strategies.

The issue of voluntarism in the RAMPD program was perhaps more categorical than in some other ITQ programs because the teacher's decision involved an either/or commitment. There was no middle ground. The teachers who agreed to join the RAMPD program were expected to meet a series of stringent expectations. Those who chose not to participate were not asked to make any commitments to CGI, additional on-line courses, or assessment of their math anxiety. The two groups of teachers continued to work independently in the same school. During the second phase of RAMPD that started in the summer of 2010, many non-participating teachers from these same schools have decided to join their CGI colleagues. In some cases a larger group of volunteers are now able to work together on critical questions of mathematics instruction. They are still volunteers, but their numbers have grown, and they are able to create their own internal support networks.

Another aspect of the voluntary character of RAMPD is the loyalty of most teachers to stay fully committed to training opportunities. Seventy-three teachers are currently active in the program, and only 16 have discontinued their participation. Many of these "drop out" decisions were involuntary because teachers lost employment due to shrinking school budgets, or they moved away from the region. Relatively few teachers voluntarily discontinued their participation.

Teachers Belonging to "Communities of Practice"

In recent years the concept "community of practice" has been borrowed from organizational studies and applied to school settings (Wenger, 1998). The two cognitive coaches who worked in the 12 participating schools were asked to construct a rubric that identifies the full range of community orientations among the RAMPD teachers in each of the schools. They constructed a four point continuum and placed the number of cases that fit into each level of community development (see Table 2).

Table 2

Community of Practice in Schools: Developmental Rubric

Rubric Category	Description of Category	Number of Schools
Low-solo practice	Teachers work primarily in a solo fashion, high isolation, low transparency, rarely communicating with peers regarding curriculum or pedagogy	$n = 3$
Moderately collaborative	Teachers occasionally consult with each other regarding curriculum content and pedagogy. Teachers exhibit willingness to learn from each other through attendance and participation in informal meetings.	$n = 3$
Highly collaborative	Teachers regularly meet to discuss best practices and to select and develop math problems for common use. Teachers are eager to learn from each other in informal and scheduled meetings. High transparency regarding content, pedagogy, and decision-making.	$n = 4$
Very highly collaborative	All the features of "highly collaborative" but these teachers go one step further to regularly allow other teachers into their classrooms.	$n = 2$

Borrowing from the insights and ideas of scholars who have written about professional collaboration in schools (Fullan, 2001; Hall & Hord, 2001), the cognitive coaches reviewed their extensive notes from three years of continuous work in the schools to construct a typology of collaboration that falls along a continuum from isolated classroom practice to highly collegial teamwork. In the spirit of grounded theory (Glaser & Strauss, 1967), they described the four distinct patterns along this continuum.

Table 2 suggests that there is wide disparity among the schools in the level of collegiality that is practiced among the math teachers. This broad range is related to the number of teachers who are available in each school for opportunities to learn from each other. Nevertheless, the findings are encouraging because there are moderate and high levels of collaboration in the majority of schools. And in two exemplary cases, a community of practice has become fully developed in the daily and weekly work habits of the teachers.

The cognitive coaches also report that the community of practice extends beyond the schools to include networks that have been formed at the joint training meetings convened by Dr. Lubinski. During full group RAMPD workshops, teachers are asked to work with or seek help from teachers from other participating schools. This has led to teacher-organized meetings in informal settings, in which teachers share their ideas and challenges (Johnston, Duvernoy, McGill & Will, 1996). There is also evidence that in some schools the RAMPD teachers are consulting with non-RAMPD teachers. This is evident in the fact that every school involved in the program, save one, added new teachers to the program when given the opportunity.

Math Anxiety Levels

Mathematics anxiety impacts a teacher in several ways. It limits a teacher's access to rich mathematical content, thereby limiting student access to rich content as well (Ashcraft & Krause, 2007). It limits a teacher's willingness to be open to teachable moments, needing rather to uncompromisingly stick to the text, thus failing to connect to students in real time (Gresham, 2008). Finally, mathematically anxious teachers have been shown to transmit math anxiety to their students (Beilock, Gunderson, Ramirez, & Levine, 2010). One cannot discuss math anxiety without recognizing a content connection. Anxiety may be reduced with greater efficacy in mathematics and mathematics instruction. However, the content may be inaccessible depending upon the degree of anxiety. High anxiety has been shown to limit the amount of working memory necessary to learn new content (Ashcraft & Krause, 2007). This project combined anxiety reducing strategies with content education. Mathematically anxious teachers had the opportunity to participate in one-on-one counseling, group counseling, small group study sessions, larger group content workshops, and whole group pedagogical instruction.

A teacher's math anxiety level was measured by the short form of the Mathematics Anxiety Rating Scale (Suinn, 2003). The results that follow are based on an analysis of the data associated with 39 teachers who had scores for both the pre- and post-test administrations of the MARS-S scale.

Table 3 reveals that 26 teachers had no math anxiety, and 13 teachers had sufficient anxiety to warrant intervention. After participating in various interventions, ten of the twelve reduced their anxiety to a "no anxiety level."

Table 3

Changes in Mathematics Anxiety Scores

Level of Anxiety	Pre-Test Numbers	Post-Test Numbers	Change
None	26	36	10
Low	5	2	-3
Medium	4	1	-3
High	4	0	-4
Total	39	39	0

One teacher moved from high anxiety to low anxiety, one teacher remained at the high anxiety level, and one teacher moved from having no anxiety to having a low level of anxiety, which is remarkable given CGI's cognitive demands. This number could have been higher. A paired samples *t*-test was computed, which indicated that these changes in anxiety levels were significant, $t\ (38) = -4.97$, $p < .001$, $d = .65$. Post-test MARS-S scores ($M = 60.28$, $SD = 15.07$) were lower than the pre-test MARS-S scores ($M = 71.92$, $SD = 20.87$), and the effect size was larger than what would typically be expected (Cohen, 1988). The computed 95% confidence interval for the difference between the means was -16.38 to -6.90 indicating that the difference could be a drop in math anxiety levels as large as approximately 16 points to approximately 7 points. RAMPD was able to make a difference for an important group of teachers who struggled with their math anxiety.

Levels of Math Content Knowledge

The teachers' content knowledge was measured by the Diagnostic Mathematics Assessment for Middle School Teachers developed at the University of Louisville (Center for Research in Mathematics and Science Teacher Development, 2008). RAMPD teachers had the opportunity to develop their content knowledge in various ways: individual coaching, study sessions, small group workshops, and online and university courses. CGI instructional strategies also contribute to developing content knowledge because the CGI philosophy opens the door to alternative approaches to problem solving. It also invites teachers to make sense not only of their students' math ability, but also of their own mathematical thinking. Thus, CGI instructional strategies increase teachers' content knowledge in the process of building pedagogical content knowledge.

A pair of pre-post math content tests was administered in the RAMPD project. As Table 4 illustrates, more than half of the teachers scored initially at a moderate ability level or above on the first test, Num-

ber Operations. The second test, Algebraic Reasoning, was more challenging and the majority of the teachers were low performers.

Table 4

Changes in Content Scores

		Post-test number operations			
		1 (low)	2 (med)	3 (high)	Total
Pre-test number operations	1 (low)	5	4	0	9
	2 (med)	3	16	2	21
	3 (high)	0	5	3	8
Total		8	25	5	38
		Post-test algebraic reasoning			
		1 (low)	2 (med)	3 (high)	Total
Pre-test algebraic reasoning	1 (low)	18	15	0	33
	2 (med)	0	2	1	3
	3 (high)	0	0	2	2
Total		18	17	3	38

Paired samples *t*-tests were computed, indicating no significant change in scores for Number Operations, but there was significant change in Algebraic Reasoning scores. For Number Operations, $t(37) = -.44$, $p = .66$ is greater than the alpha level (.05). Post-test Number Operations scores ($M = 19.50$, $SD = 7.30$) were lower than the pre-test Number Operations scores ($M = 19.87$, $SD = 7.88$). The computed 95% confidence interval for the difference between the means was -2.07 to 1.34 indicating that the difference could be a drop in approximately 2 points to an increase in approximately 1 point. In the case of Algebraic Reasoning, where there was significance, $t(37) = 7.23$, $p < .001$, $d = .74$. Post-test Algebraic Reasoning scores ($M = 14.18$, $SD = 7.37$) were higher than the pre-test Algebraic Reasoning scores ($M = 8.79$, $SD = 7.14$), and the effect size was larger than what would typically be expected (Cohen, 1988). The computed 95% confidence interval for the difference between the means was 3.88 to 6.90, indicating that the difference could be an increase in as little as approximately 4 points to as much as approximately 7 points. RAMPD was able to make a difference for an important group of teachers who improved their Algebraic Reasoning.

Assessment of Student Learning

Professional development of teachers is of little benefit if it does not ultimately enhance student achievement. The RAMPD leaders recognized the need to assess the students' math ability as critical to the success of their

program. Rooted in CGI is the fact that teachers use what students know as the foundation for new knowledge. Therefore, formative assessment, or assessment for knowledge, is a regular practice (Black & Wiliam, 1998). As teachers gained in their ability to operate within a CGI framework, they improved in assessment of student learning. Teachers were coached about specific assessment procedures that were posted on the project website. These assessment methods included the use of rubrics provided by the National Council of Teachers of Mathematics (McGatha & Darcy, 2010; Stenmark, 1991) and the Illinois State Board of Education (ISBE, 2005a, 2005b).

At this time no formal analysis of Illinois Standards Achievement Test (ISAT) math scores has been conducted, but a comprehensive study is currently under way. Nevertheless, some principals have reported that achievement gains have been made by students in RAMPD classrooms. The RAMPD program has focused on various formative assessment strategies that provide continuous feedback to teachers and students in the daily work of math instruction, an approach consistent with CGI principles.

Formal structural analysis of student work commenced with how to use the CGI framework of student strategies and problem types. There were three distinct and deliberate attempts to ascertain and influence student achievement and use assessment evidence to inform practice. First, teachers practiced identifying achievement levels via the CGI framework of strategies and problem types, and they learned to make real time adjustments to their instructional plans based on their understanding of student performance. Second, teachers made inquiries into how to evaluate student work while making a transition to problem based instruction. Rubric scoring formats were discussed, and selected samples were posted on the project website. Third, on four occasions, RAMPD teachers met in grade level clusters and worked in group settings to assess student math abilities based on the Illinois Learning Standards for Mathematics (ISBE, 2010). During these sessions, teachers worked together to arrive at a consensus about the variability of student performance within a given grade level. After an analysis of student work, specific suggestions were then given on how to best help students meet performance standards, including whole class strategies and differentiated instruction for individuals and subgroups. Together, these three training strategies encouraged teachers to see the power of formative assessments that can enhance student learning.

Conclusion

Implementing new professional development programs through school-university partnerships is never simple. There are multiple complexities (anticipated and unanticipated) in these collaborative ventures. This brief description of the RAMPD partnership provides an opportunity to explore some of these complexities. Meredith Honig (2006) captures the spirit of this case study in her assertion that implementation must be

seen "as a complex and highly contingent enterprise in which variation is the rule, rather than the exception" (p. 4). RAMPD is a remarkable example of contingencies and variations.

The present project began with strong mutual commitment from senior administrators at a regional state university and the elementary school district located in the university town. A more proximate and convenient partnership is hard to imagine. Yet the four local schools with immediate access to the rich resources of RAMPD varied from strong to weak in their degree of interest and commitment. Some school leaders and teachers were highly receptive to the opportunities offered by RAMPD, but others were indifferent.

The strength of a school-university partnership rests on the power of usable and sustained expertise provided by university professors and staff who can deliver valued human and material resources to local schools. In some cases, universities do not provide this expertise, but rather, use outside experts who come for quick delivery of specialized knowledge offered as PowerPoint presentations and easily digested materials (e.g, books, DVDs, resource packets). In the case of SIU-Carbondale the key expert was not from SIUC; a brokered arrangement was made with a retired Illinois State University professor who happened to be living in the region. This unique circumstance allowed a nationally recognized CGI scholar and educator to become a regional asset who was continually available for large group training sessions, consultations with cognitive coaches, and repeated school visits to work with teachers who were developing their CGI skills. Dr. Lubinski may have been an outside consultant, but her continued presence in local settings was a major factor that explains the strong and sustained loyalty to CGI training among RAMPD teachers. The lead trainer and cognitive coaches delivered their expertise as relational knowledge that connected to the real world experiences of classroom teachers.

During the past four years, 89 teachers from 12 schools have participated in RAMPD. Their learning experiences and those of their students cannot be described as a one-size-fits-all-cookie-cutter prescription for professional learning and school improvement. RAMPD is about CGI; and CGI is not designed as an easy-to-learn, quick fix formula that assures fast turn-around for high poverty schools. CGI is about rigorous and deep learning that requires risk taking and sustained hard work to master new teaching skills. This professional learning program, with its claims to improve student learning, requires a set of skills and knowledge that Barbara Chow (2010) argues is currently lacking in many professional development programs. The attributes of rigorous and deep learning outlined by Chow are highly descriptive of the CGI program. Her criteria for rigorous and deeper learning for both teachers and students include the following:

1) Mastering core academic content;
2) Thinking critically and solving problems;
3) Working collaboratively in groups;

4) Communicating clearly and effectively; and
5) Learning how to learn (p.22).

These five core activities characterize CGI in the SIUC partnership. Additionally, RAMPD offered a set of personalized and challenging teacher learning experiences. Each teacher was invited to participate in CGI with the awareness of personal and unique strengths and weaknesses. RAMPD was designed to respond to the enormous variability among the teachers—their anxieties, their knowledge of math, and their skill level as teachers. The program was not designed to move everyone to the same learning outcome. There is too much variation for such a simplistic goal. Just as each teacher is expected to respond to the many variations found among their students on the first day they meet them in class, so the RAMPD trainers began the learning process with each teacher according to his or her own prior learning experiences. For both teachers and students CGI embraces the truth of human variability in all its dimensions. While RAMPD accepts this variability as given, teachers are expected to become the best math instructors they can imagine. The search for excellence begins in the realities of variation.

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